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FLEET RELIABILITY ASSESSMENT PROGRAM EQUIPMENT REPORT AN/USQ-69--ETC(U)
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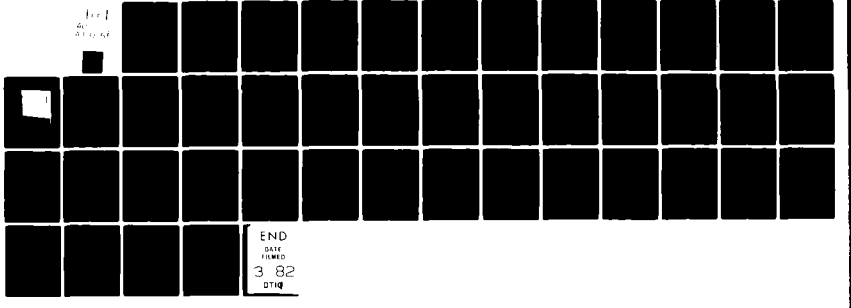

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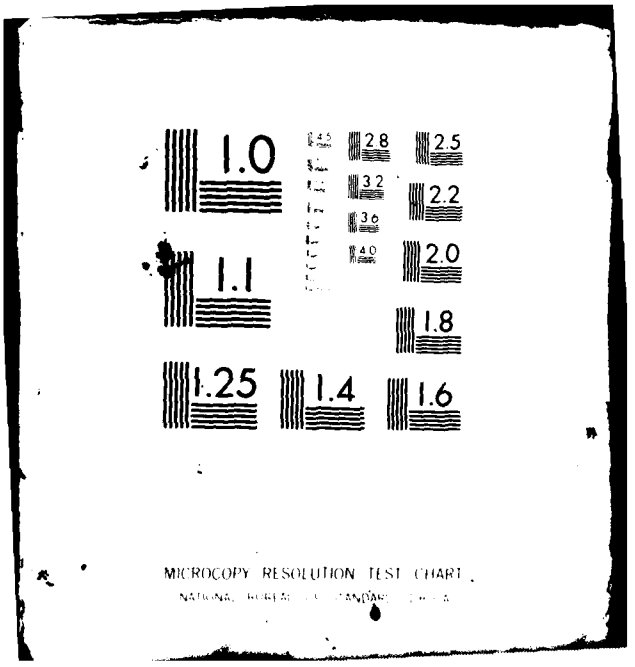
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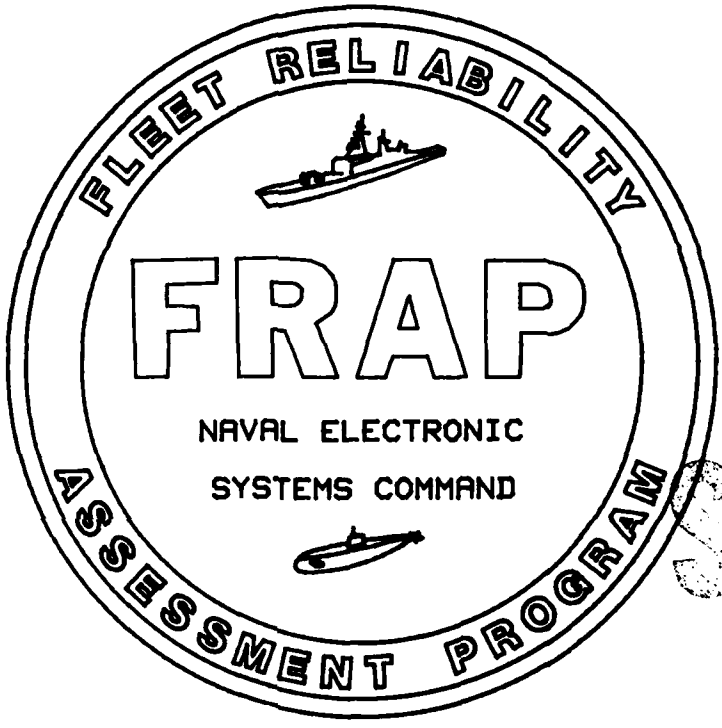

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EQUIPMENT REPORT

AN/USQ-69(V)

NAVAL WEAPONS SUPPORT CENTER

CRANE, INDIANA

Published by the direction of Commander Naval Electronic Systems Command

JULY 1981

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This report present Fleet Reliability Assessment Program collection and analysis on the AN/USQ-69(V) Data Terminal Set in field use.

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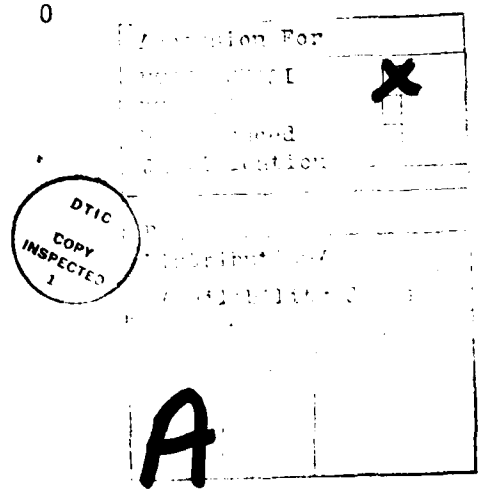

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FLEET RELIABILITY ASSESSMENT PROGRAM

DEPARTMENT OF THE NAVY

NAVAL ELECTRONICS SYSTEMS COMMAND

EQUIPMENT REPORT

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AN/USQ-69(V)
DATA TERMINAL SET
EQUIPMENT RELIABILITY REPORT

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

SECTION I - RESULTS SUMMARY

1-1 RESULTS

From April 1979 to March 1981, a FRAP field study was conducted on the AN/USQ-69(V) Data Terminal Set. A total of 74,250 operating hours out of 213,216 calendar hours were accumulated on 23 systems. A total of 4 equipment failures were reported from OPNAV A790/2K maintenance action forms and messages resulting in an observed Mean-Time-Between-Failure (MTBF) of 18,562 hours. Two additional failures were reported via CASREP which further reduced the MTBF to 12,375 hours.

Reported repair time for 4 completed actions (5 failures) was included on only one report. Therefore, utilizing NAVMATINSTR 3000.2, 10 hours per repair was included for each of the remaining 3 failures. This resulted in a Mean-Time-To-Repair (MTTR) of 8 hours.

The AN/USQ-69(V) Operational Availability was 0.9743. However, an additional 3,038 down time hours (CASREP reported) reduced the point estimate Operational Availability to .9545. The cause of the largest amount of down time was a Cathode Ray Tube replacement on the USS Daniels.

Table 1-1 summarizes the RMA results. In Table 1-1, the Operational analysis describes the RMA performance of the system in Fleet operation and takes into account the system design, equipment design, operator training, maintenance training, operation/maintenance documentation effectiveness, and shipboard administrative procedures. The Equipment analysis describes the RMA performance of the equipment only and provides a basis of comparison with the contractually-specified RMA performance. The Parts Replacement analysis provides a means of judging the logistics demand on the supply system and some insight into the impact upon the ship's maintenance workload of the system's RMA performance.

The assessment procedure described in Volume I - General Program Report (Section IV) of September 1979 is used to perform all the analyses. The difference is in the criteria used to select the data to be analyzed. Data set selection criteria are as follows.

(1) OPERATIONAL RMA ANALYSIS. Failures causing a 10 percent or greater loss of system capability are selected. Active maintenance time from Block 32 of the OPNAV 4790/2K form is used for repair time calculation.

(2) EQUIPMENT RMA ANALYSIS. Failures of the equipment to perform its intended function because of hardware or software malfunction are selected. Active maintenance time from Block 32 of the OPNAV 4790/2K form is used for repair time calculation.

(3) PARTS REPLACEMENT RMA ANALYSIS. Failures requiring replacement of a part (module, circuit card, or component) are selected. Ship's Force Repair Man-hours from Block 30 of the OPNAV 4790/2K form is used for repair time calculation.

1. OPER. = OPERATIONAL
2. EQUIP. = EQUIPMENT
3. PARTS = PARTS REPLACEMENT
* See SECTION VII - ANALYSES

TABLE 1-1. DATA SUMMARY FOR AN/USQ-69V.

PARAMETER	OPER	EQUIP	PARTS
OPERATIONAL			
Calendar Hours	213,216	213,216	213,216
Operating Hours	74,250	74,250	74,250
Duty Cycle	0.348	0.348	0.348
Sample Size	23	23	23
*RELIABILITY			
Number of Failures	6	6	7
Time Between Failures-Mean	12,375	12,375	10,607
Time Between Failures-Median	4060	4060	4060
Distribution	WEIBULL	WEIBULL	WEIBULL
MAINTAINABILITY			
Total Repair Time	32	32	32
Number of Repairs	4	4	4
Time to Repair-Mean	8.00	8.00	8.00
Time to Repair-Median	6.7	6.7	6.7
Distribution	LOGNML	LOGNML	LOGNML
Total Down Time	502	502	502
Repairs (with Down Time)	4	4	4
Down Time-Mean	125.50	125.50	125.50
Down Time-Median	17.6	17.6	17.6
Distribution	LOGNML	LOGNML	LOGNML
AVAILABILITY			
Inherent	.9994	.9994	.9994
Observed-Mean	.9743	.9743	.9743
Observed-Median	.9978	.9978	.9978
Effective	.9994	.9994	.9994

NOTE: All time units are in hours.

Table 1-2 summarizes the WRA's (Weapons Replaceable Assemblies) and O-Levels which failed. It should be noted that the AN/USQ-69 is assigned WRA 18 and that the WRA and O-Level assignments are exclusively FRAP assignments to conveniently identify elements of systems and subsystems. A cross reference of O-Levels to reference designators and part numbers is shown in Figure 6-1a and 6-1b, AN/USQ-69(V) Reliability Block Diagram. In Table 1-2, the O-Level failures reported by CASREP are indicated with an asterisk.

1-2 Problems. The AN/USQ-69 exhibited no apparent chronic problems. The most frequent failures occurred with the keyboard assembly 1A3. This was reported to have failed three times, of which, one of the failures was human error. Other failures included the Low Voltage Power Supply, a Cathode Ray Tube, and Panel/Keyboard/1 Page Ram Module 1A1A3A5.

1-3 Conclusions/Recommendations. It is concluded that the AN/USQ-69(V) meets or exceeds the MTBF of 5,000 hours as specified by ELEX-D-186. The Mean-Time-To-Repair exceeds the specified 15 minutes. However, it should be noted that the calculated MTTR includes estimated times to repair and therefore cannot be viewed as conclusive. It can be concluded, however, that trouble isolation is not a problem for technicians repairing the AN/USQ-69. This conclusion is based on contact with ship's personnel responsible for maintaining the Data Terminal Set.

It is recommended that logistics support for the AN/USQ-69 be re-evaluated. Spares support from central supply sources was apparently weak, which resulted in excessive down time on several failures.

It is also recommended that the Keyboard Assembly 1A3 be tracked to determine the failure trend. The assembly did not meet the predicted failure rate during the sample period.

TABLE 1-2. SUMMARY OF WRA AND O-LEVEL ASSEMBLIES FAILING

WRA	O LEVEL	REF DES	DESCRIPTION (NAME)	OPER	EQUIP	PARTS
18			AN/USQ-69(V) DTS			
	*002	1A2A1	CATHODE RAY TUBE	1	1	1
	011	1A1A3	PANEL/KYBD/1PAGE RAM	1	1	1
	*016	1A1PS1	POWER SUPPLY	2	2	2
	017	1A3	KEYBOARD	2	2	3
TOTAL				6	6	7

* Includes CASREP Failures

SECTION II - DESCRIPTION

2-1 General. The AN/USQ-69 Data Terminal Set is an alpha-numeric, digital data display device designed to provide a reliable interface between operator and combat computers such as the AN/UYK-20 and AN/UYK-7. The unit provides the means for the operator to assemble a message from a keyboard for local display or entry into a computer. It also provides the computer with a remote display unit for data output. The AN/USQ-69, shown in Figure 2-1, is manufactured by Sperry-Univac, Clear Water, Florida.

2-2 Mission. The AN/USQ-69 serves as a computer system peripheral input/output (I/O) device with various weapons systems. Examples are the Carrier Air Traffic Control Center Direct Altitude and Identity Readout (CATC-DAIR) system and Naval Modular Automated Communications System (NAVMACS A+ and NAVMACS B). Additionally, the AN/USQ-69 is being considered as a part of the I/O display device for the AEGIS weapons system. The Data Terminal Set (AN/USQ-69) can be considered a "building block" for general purpose digital system developement.

2-3 Equipment Description. The AN/USQ-69 is a remote operated keyboard input, cathode ray tube output display device, used for operator/computer interface. The AN/USQ-69(V) Functional Block Diagram is shown in Figure 2-2.

2-4 Sample Platforms. The Platforms selected for monitoring the AN/USQ-69 Data Terminal Set are shown in Tables 2-1 and 2-2.

Table 2-1. FRAP Sample Platforms (LANTFLT)

Ship Name	Hull Number	Type
AMERICA	CV-66	Aircraft Carrier
DANIELS (JOSEPHUS)	CG-27	Guided Missile Cruiser
PUGET SOUND	AD-38	Destroyer Tender
TURNER (RICHMOND K)	CG-20	Guided Missile Cruiser
WAINWRIGHT	CG-28	Guided Missile Cruiser

Table 2-2. FRAP Sample Platforms (PACFLT)

CORAL SEA	CV-43	Aircraft Carrier
FOX	CG-33	Guided Missile Cruiser
KITTY HAWK	CV-63	Aircraft Carrier
RANGER	CV-61	Aircraft Carrier
STANDLEY (WILLIAM H.)	CG-32	Guided Missile Cruiser
TRUXTUN	CGN-35	Guided Missile Cruiser (Nuclear)

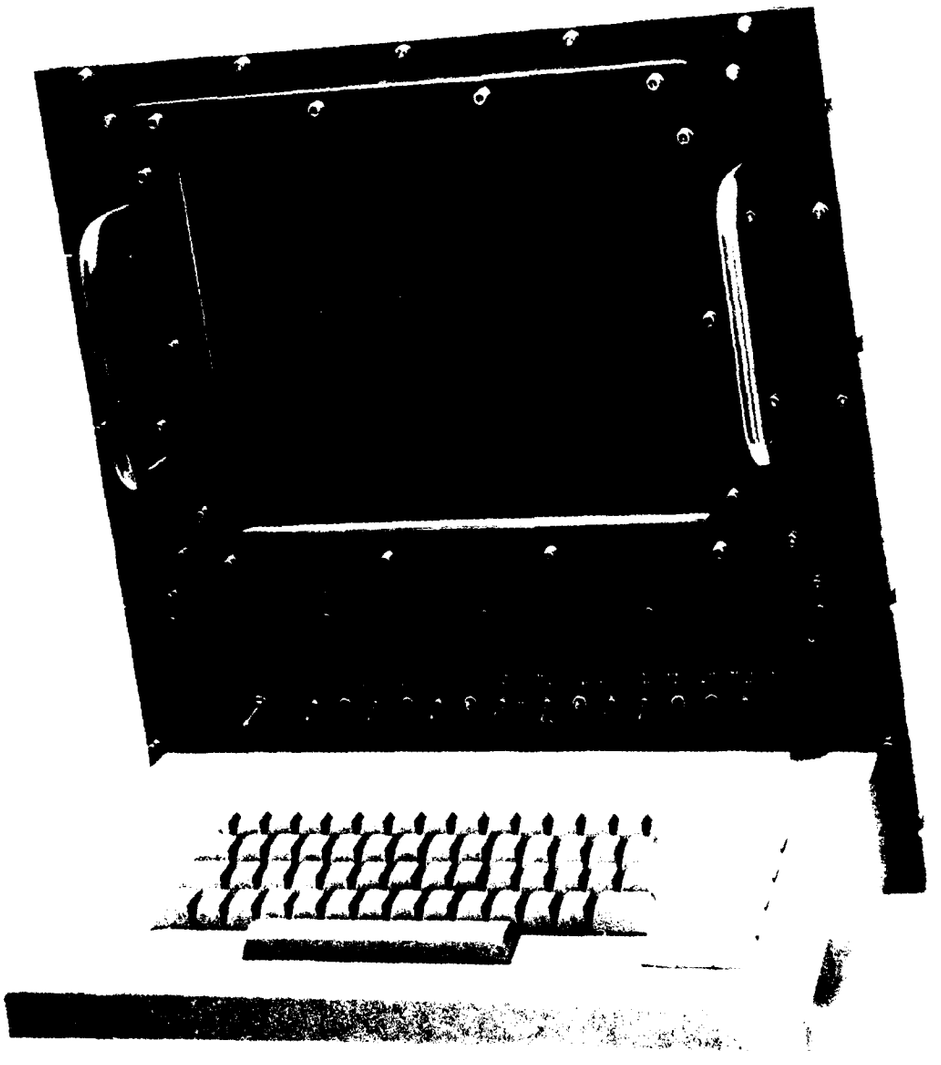


FIGURE 2-1. AN/USQ-69(V) DATA TERMINAL SET

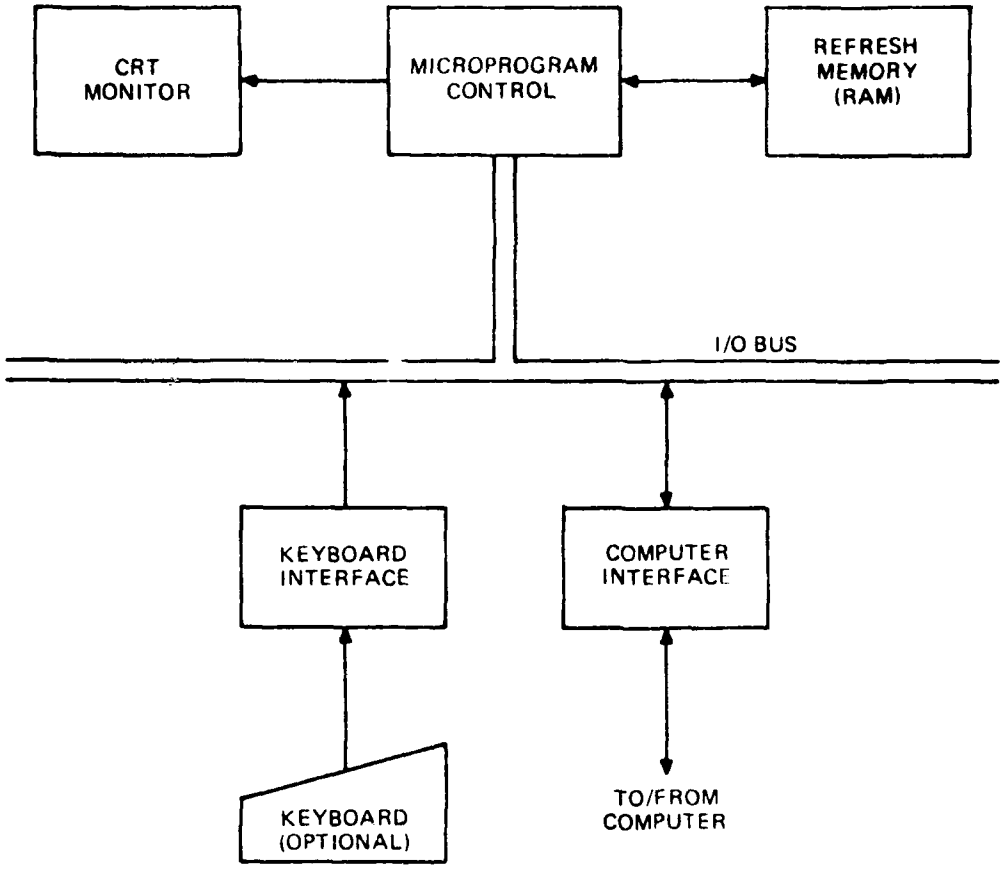


FIGURE 2-2. AN/USQ-69(V) FUNCTIONAL BLOCK DIAGRAM

SECTION III - SPECIFICATIONS

3-1 Reliability. The specified Mean-Time-Between-Failure for the AN/USQ-69 Data Terminal Set is 5,000 hours (0_0 as defined by MIL-STD-785).

3-2 Maintainability. Any configuration of the AN/USQ-69 is specified at .25 hour for mean corrective maintenance time and a maximum corrective maintenance time (M max) of two hours at a 95 percentile confidence level when repair is accomplished by replacement of line replaceable items and chassis mounted components.

3-3 Availability. Availability is not specified for the AN/USQ-69. The equipment operational availability is, however, related to Mean-Time-Between-Failure, ease of maintenance, and problem isolation. Operational availability is also influenced by the user's accessibility to spares and to logistics system response.

SECTION IV - PROBLEMS

4-1 Hardware Problems. The areas of most frequently encountered problems were the keyboard and the Low Voltage power supply. The three failures of the keyboard assembly, 1A3, resulted in replacement of the assembly. One of the assemblies was damaged when coffee was accidentally spilled on the keyboard. Other failures included one CRT, one panel/keyboard/1 page Ram module, and two power supply failures. The USS FOX reported numerous heat problems requiring operation with the logic drawer open to obtain adequate cooling. The USS RANGER reported a power supply capacitor failure, just prior to FRAP initialization, which was concluded to be heat related.

4-2 Software Problems. No software problems were observed to be attributable to this equipment.

SECTION V - CORRECTIVE ACTIONS (RECOMMENDATIONS)

5-1 No reliability oriented corrective actions are recommended for the AN/USQ-69(V), based on the available data.

SECTION VI - EQUIPMENT RELIABILITY MODEL

System reliability is defined as the probability of performing a specified function or mission under specified conditions for a specified time. Reliability models are word statements or block diagrams which represent the requirements for mission success. The FRAP equipment models are used to determine the achieved operational reliability and to assess the effect of ECPs and other corrective action upon system reliability. Maintenance Action Reports are compared against the model to determine if a reported failure results in a system failure, or if not a system failure, then the degree of system degradation. In addition, reliability models are used in determining logistics support requirements in the development phases of an equipment life cycle.

Maintenance of Naval shipboard equipment is accomplished by replacement or repair of components at Organizational (O), Intermediate (I), or Depot(D) repair levels. Ships Maintenance and Material Management (3-M) normally collects organizational level repair data but not intermediate or depot level repair data. Using 3-M field data requires that the lowest components of the model be the lowest level reported by 3-M, i.e., the O-level replaceable component. This O-level component can be a piece-part, printed circuit board, major assembly, or whatever is planned for the O-level maintenance concept.

Figures 6-1a and 6-1b define the reliability block diagram for the AN/USQ-69 Data Terminal Set. The DTS is referred to as WRA 18 in the report where WRA stands for Weapons Replaceable Assembly (the Equipment indenture level).

The maintenance concept for the DTS is plug-in subassemblies or modules. In Figures 6-1a and 6-1b, the modules have been assigned O-Level numbers 001 through 022. O-Level number 999 has been assigned to all other DTS piece parts. The blocks containing the O-Level numbers also contain the predicted failure rate figure per million operating hours (Lambda).

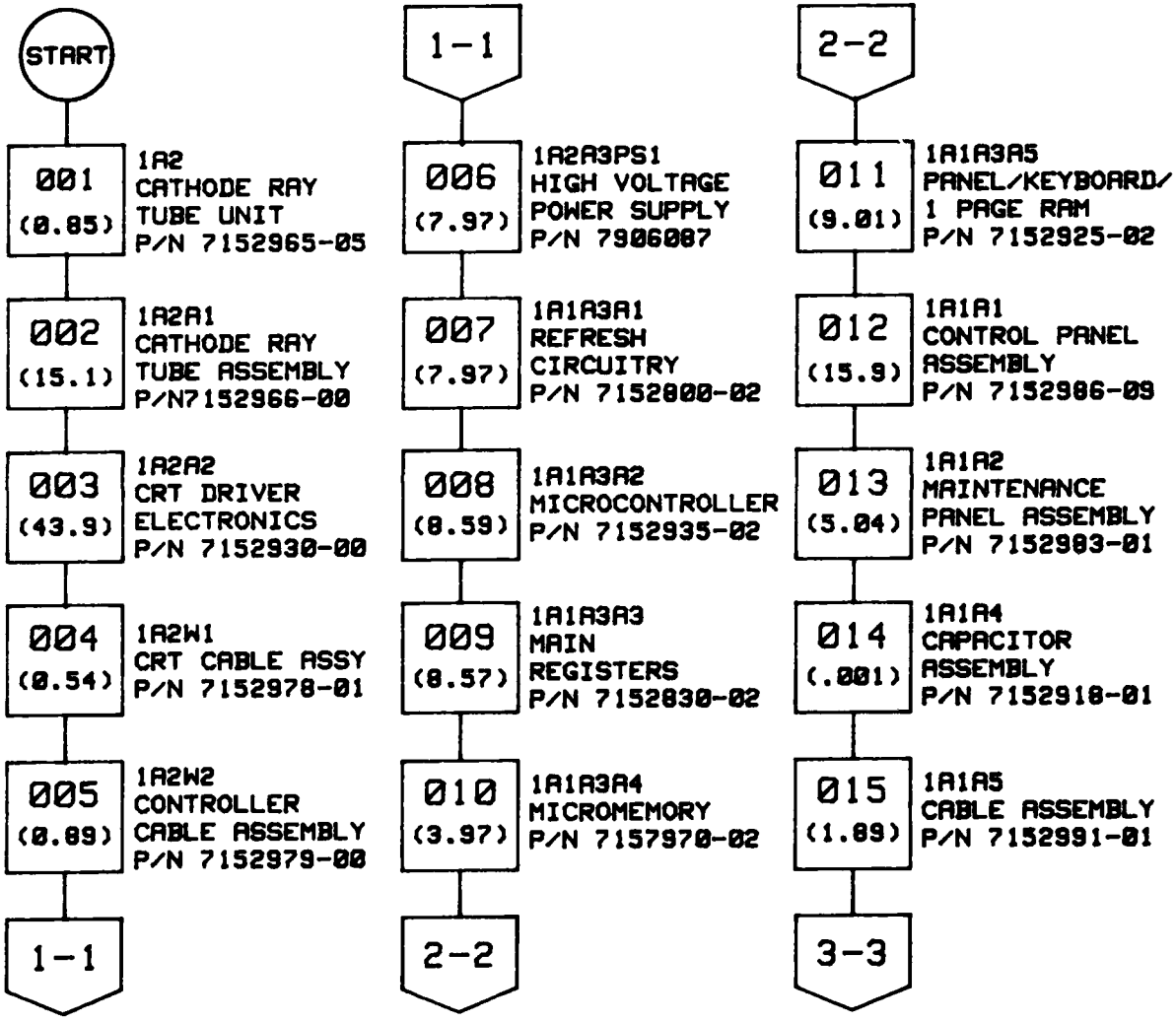


FIGURE 6-1a. AN/USQ-69(V) Reliability Block Diagram

NOTE:
1. System λ = 198.82
2. Lambda (λ) is the predicted failure rate per million operating hours.
3. Block entries in ( ) indicate predicted O-Level Lambda values.

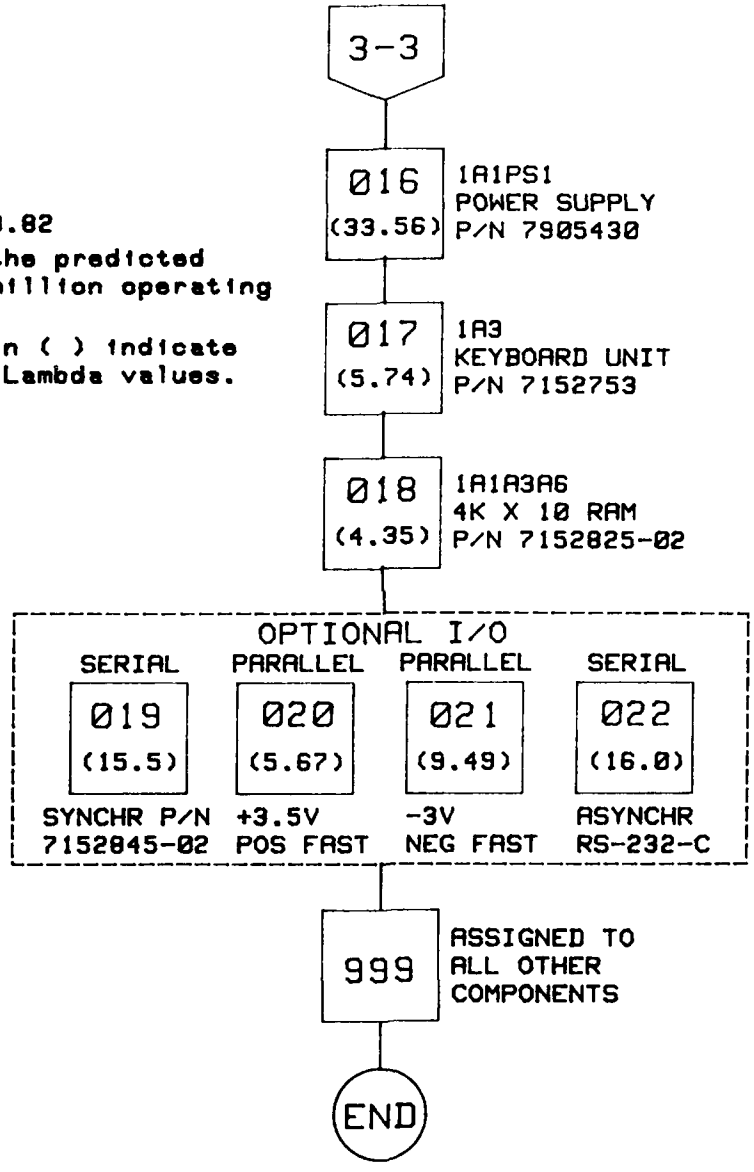


FIGURE 6-1b. AN/USQ-69(V) Reliability Block Diagram

SECTION VII - ANALYSES

7-1 Reliability.

a. Operational Reliability.

Utilizing all available data including CASREPs and messages, the observed Mean-Time-Between-Failure for the AN/USQ-69(V) was 12,375 hours and the Median-Time-Between-Failure was 4,060 hours. (Table 7-1 interleaves the CASREP and OPNAV 4790/2K data showing the Mean-Time-Between-Replacements for both individual ships and for all ships in the sample).

At least one failure of a keyboard assembly (on the Puget Sound) is known to have occurred approximately 3 months earlier in time than was reported. Utilizing the CASREP/CASCOR dates and the duty cycle of the failed serial number, the data was adjusted to reflect the corrected failure time. From the analysis of the data, the Weibull distribution function was determined to be a better fit to the data (reported by OPNAV 4790/2Ks only) than the Exponential distribution. Parameters of the best-fit Weibull distribution are:

Mean = 14,212.7 hours
Median = 11,118.5 hours

TABLE 7-1

AN/USQ-69(V) Reported Replacements
CASREPTS and FRAP

Ship Name	Reported Hours	Reported Replacement	Reported CASREPTS	Ship MTBR
AMERICA	0	0	0	0
CORAL SEA	0	0	0	0
DANIELS, JOSEPHUS	2,319	0	2	1,159.5
FOX	5,533	0	0	5,533
KITTY HAWK	15,813	0	0	15,813
PUGET SOUND	15,707	2	0	7,853
RANGER	2,620	0	0	2,620
STANDLEY, WILLIAM	7,237	1	0	7,237
TRUXTUN	2,821	2	0	1,410.5
TURNER, RICHMOND K.	22,200	0	0	22,200
WAINWRIGHT	0	0	0	0
	74,250	5	2	10,607

b. Equipment Reliability. The observed Mean-Time-Between-Failure for the Equipment Reliability includes all failures except a keyboard failure which occurred on the USS Standley as a result of human error. The observed MTBF was 14,850 hours and the Median-Time-Between-Failure was 4,060.5 hours.

The analysis of the data (excluding CASREPs) is shown in Figures 7-1 and 7-2.

Since the analysis includes less than 4 equipment failures, an Exponential distribution is assumed. Fewer than 4 failures provides insufficient data to accurately fit the Weibull distribution. Parameters of the Exponential distribution are:

Mean = 24,750 hours
Median = 17,155.4 hours

7-2 Maintainability.

a. Repair Time. Action Maintenance Time was entered on only one of the five failures reported by OPNAV 4790/2K forms. Therefore, utilizing NAVMAT INSTR 3000.2, 10 hours per repair was included for each of the remaining completed actions. The result is described by a Lognormal distribution with the following parameters:

Mean = 8.0 hours
Median = 6.7 hours

b. Down Time. The Down Time analysis resulted in a Lognormal distribution with parameters:

Mean = 125.5 hours
Median = 17.6 hours

However, the addition of 3,038 CASREP reported down time hours results in a point estimate Mean Down Time of 590 hours for a total of 6 repair actions.

7-3 Availability.

a. Inherent. The Inherent Availability, which can be considered a theoretical limit of Operational Availability, was found to be 0.9994.

b. Operational. Operational Availability was determined from a Monte Carlo simulation process using the Reliability function found in Paragraph 7-1a and the Down Time function found in Paragraph 7-2. The resulting Operational Availability distribution parameters are:

Mean = .9743
Median = .9978

It should be noted that an additional 3,038 down time hours reported via CASREP reduced the Operational AVailability to a point estimate mean of 0.9545.

7-4 Analysis Terminology.

Non-parametric Distribution (NPD). A probability distribution resulting from the order statistics approach of determining an unknown failure distribution.

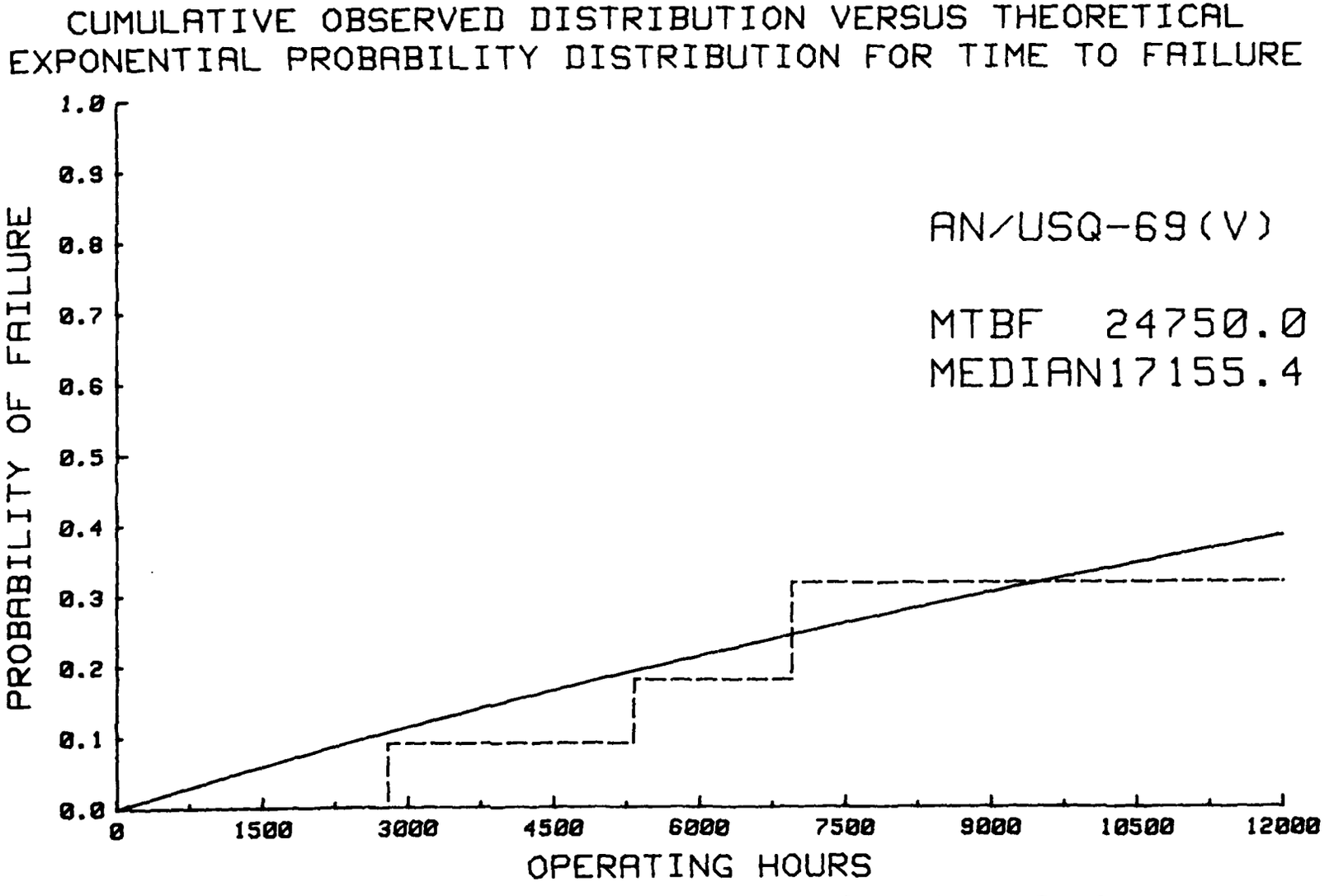


FIGURE 7-1. Analysis Result Excluding Standley Failure

```
EQUIPMENT OPERATING HOURS(O.H.) =  74250.0
CALENDAR HOURS(C.H.) =213216.0
DUTY CYCLE (O.H./C.H.) =    .348
NUMBER OF FAILURES =  3
OBSERVED FAILURE RATE/O.H. =4.0404E-05
****LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED*****
```


FIGURE 7-2. Analysis Data Excluding Standley Failure

The distribution is calculated by arranging failure times and censored times (failure free times) in ascending order and computing the cumulative probability of failure.

Exponential Distribution - a probability distribution derived from calculations using a constant failure rate.

Weibull Distribution - A probability distribution derived from calculations using scale and shape parameters, Alpha and Beta. The value of Beta is used to determine the failure trend where for Beta less than 1, the reliability is increasing and, for Beta greater than 1, decreasing reliability. The Weibull and Exponential distributions are the same for Beta equal to 1, i.e., the failure rate is constant.

SUBSECTION (1)

AN/USQ-69(V) OPERATIONAL RELIABILITY

INDEX FOR FLEET RELIABILITY ASSESSMENT DATA

COLUMN

1 SHIP - Platform name

2 EQUIP S/N - Serial number of equipment under observation

3 JULIAN DATE - Date of OPNAV 4790/2K REPORT

4 ETM - Elapsed Time Meter reading

5 DUTY CYCLE - Ratio of operating or ON time to calendar time

6 REPORT TYPE - OPNAV 4790/2K Report type classified as any of the following:

a. START - FRAP Initialization establishing equipment time frame reference point

b. DEFERRED - An incompleted maintenance action

c. COMP - A completed maintenance action which had no prior deferral

d. FAIL-DEF - A completed maintenance action for which there was a prior deferral

e. UPDATE - A failure free time report - used to track equipment usage

f. FINAL - A report of equipment status and of the ETM reading upon termination of the FRAP sample interval

7 TBF - Time Between Failures (or Time To Termination) using the START report as the zero reference time

8,9 OLVL1,OLVL2 - Reliability block diagram number identification of failed components

FLEET RELIABILITY ASSESSMENT DATA

SHIP	EQUIP S/N	JULIAN DATE	ETM	DUTY CYCLE	REPORT TYPE	TBF	OLVL1	OLVL2
AMERICA	A3	80158	0	0.000	START	0.0	0	0
CORAL SEA	A115	79267	303	0.000	START	0.0	0	0
NO INITIAL DATA ---- FIRST RECORD USED.								
DANIELS (JOSEPHUS)	A13	81042	9119	0.000	START	0.0	0	0
DANIELS (JOSEPHUS)	A13	81117	10003	.491	FINAL	884.0	0	0
NO INITIAL DATA ---- FIRST RECORD USED.								
DANIELS (JOSEPHUS)	A37	81042	9635	0.000	START	0.0	0	0
DANIELS (JOSEPHUS)	A37	81117	9635	0.000	FINAL	0.0	0	0
NO INITIAL DATA ---- FIRST RECORD USED.								
DANIELS (JOSEPHUS)	A41	81042	10616	0.000	START	0.0	0	0
DANIELS (JOSEPHUS)	A41	81117	12051	.797	FINAL	1435.0	0	0
FOX	A102	80127	1537	0.000	START	0.0	0	0
FOX	A102	80152	1582	.075	UPDATE	0.0	0	0
FOX	A102	80182	1944	.308	UPDATE	0.0	0	0
FOX	A102	80213	2101	.273	UPDATE	0.0	0	0
FOX	A102	80245	2220	.241	UPDATE	0.0	0	0
FOX	A102	80273	2751	.346	UPDATE	0.0	0	0
FOX	A102	80320	3942	.519	UPDATE	0.0	0	0
FOX	A102	81102	7070	.678	UPDATE	0.0	0	0
FOX	A102	81103	7070	.676	FINAL	5533.0	0	0
KITTY HAWK	A42	79102	3200	0.000	START	0.0	0	0
KITTY HAWK	A42	80079	7155	.482	UPDATE	0.0	0	0
KITTY HAWK	A42	80280	7158	.304	UPDATE	0.0	0	0
KITTY HAWK	A42	81040	9574	.204	FINAL	6374.0	0	0
KITTY HAWK	A88	79101	4270	0.000	START	0.0	0	0
KITTY HAWK	A88	80079	10055	.703	UPDATE	0.0	0	0
KITTY HAWK	A88	80280	10820	.502	UPDATE	0.0	0	0
KITTY HAWK	A88	81040	12615	.267	FINAL	8345.0	0	0
KITTY HAWK	A312	80280	341	0.000	START	0.0	0	0
KITTY HAWK	A312	81040	519	.059	FINAL	178.0	0	0
KITTY HAWK	A313	80280	427	0.000	START	0.0	0	0
KITTY HAWK	A313	81040	1343	.305	FINAL	916.0	0	0

FLEET RELIABILITY ASSESSMENT DATA

SHIP	EQUIP S/N	JULIAN DATE	ETM	DUTY CYCLE	REPORT TYPE	TBF	OLVL1	OLVL2
PUGET SOUND	A96	80107	702	0.000	START	0.0	0	0
PUGET SOUND	A96	80135	1215	.763	UPDATE	0.0	0	0
PUGET SOUND	A96	80185	2084	.738	UPDATE	0.0	0	0
PUGET SOUND	A96	80365	6031	.861	FAIL-DEF	5329.0	18017	0
PUGET SOUND	A129	80107	1791	0.000	START	0.0	0	0
PUGET SOUND	A129	80155	2771	.851	UPDATE	0.0	0	0
PUGET SOUND	A129	80185	3453	.888	UPDATE	0.0	0	0
PUGET SOUND	A129	81116	3487	.189	FINAL	1696.0	0	0
PUGET SOUND	A147	80107	1806	0.000	START	0.0	0	0
PUGET SOUND	A147	80155	2784	.849	UPDATE	0.0	0	0
PUGET SOUND	A147	80185	3469	.888	UPDATE	0.0	0	0
PUGET SOUND	A147	81116	3537	.193	FINAL	1731.0	0	0
PUGET SOUND	A159	80107	2035	0.000	START	0.0	0	0
PUGET SOUND	A159	80155	3015	.851	UPDATE	0.0	0	0
PUGET SOUND	A159	80185	3687	.882	UPDATE	0.0	0	0
PUGET SOUND	A159	81114	8986	.779	COMP	6951.0	18017	0
PUGET SOUND	A159	81115	8986	.776	FINAL	0.0	0	0
RANGER	A309	80141	277	0.000	START	0.0	0	0
RANGER	A309	81138	1897	.186	FINAL	1620.0	0	0
RANGER	A311	80141	221	0.000	START	0.0	0	0
RANGER	A311	81138	1221	.115	FINAL	1000.0	0	0
STANDLEY (WILLIAM	A66	79142	2841	0.000	START	0.0	0	0
STANDLEY (WILLIAM	A66	79164	3153	.591	COMP	312.0	18017	0
STANDLEY (WILLIAM	A66	81033	8866	.200	FINAL	5713.0	0	0
NO INITIAL DATA ---- FIRST RECORD USED.								
STANDLEY (WILLIAM	A149	80309	5831	0.000	START	0.0	0	0
STANDLEY (WILLIAM	A149	81033	7043	.567	FINAL	1212.0	0	0
TRUXTUN	A117	79317	283	0.000	START	0.0	0	0
TRUXTUN	A117	80092	1642	.404	UPDATE	0.0	0	0
TRUXTUN	A117	80346	3075	.295	FAIL-DEF	2792.0	18016	18011
TRUXTUN	A117	81005	3104	.112	FINAL	29.0	0	0
TURNER (RICHMOND K	A78	80128	3014	0.000	START	0.0	0	0

FLEET RELIABILITY ASSESSMENT DATA

SHIP	EQUIP S/N	JULIAN DATE	ETM	DUTY CYCLE	REPORT TYPE	TBF	OLVL1	OLVL2
TURNER (RICHMOND K	A78	80158	3655	.890	UPDATE	0.0	0	0
TURNER (RICHMOND K	A78	80193	4507	.957	UPDATE	0.0	0	0
TURNER (RICHMOND K	A78	80271	6406	.988	UPDATE	0.0	0	0
TURNER (RICHMOND K	A78	81010	8847	.984	UPDATE	0.0	0	0
TURNER (RICHMOND K	A78	81033	9403	.986	UPDATE	0.0	0	0
TURNER (RICHMOND K	A78	81062	10102	.988	UPDATE	0.0	0	0
TURNER (RICHMOND K	A78	81083	10528	.978	FINAL	7514.0	0	0
TURNER (RICHMOND K	A82	80128	1688	0.000	START	0.0	0	0
TURNER (RICHMOND K	A82	80157	2330	.922	UPDATE	0.0	0	0
TURNER (RICHMOND K	A82	80193	3194	.965	UPDATE	0.0	0	0
TURNER (RICHMOND K	A82	80271	5034	.975	UPDATE	0.0	0	0
TURNER (RICHMOND K	A82	81010	7419	.967	UPDATE	0.0	0	0
TURNER (RICHMOND K	A82	81033	7957	.967	UPDATE	0.0	0	0
TURNER (RICHMOND K	A82	81083	9070	.961	FINAL	7382.0	0	0
TURNER (RICHMOND K	A91	80128	2014	0.000	START	0.0	0	0
TURNER (RICHMOND K	A91	80170	2653	.634	UPDATE	0.0	0	0
TURNER (RICHMOND K	A91	80193	3505	.956	UPDATE	0.0	0	0
TURNER (RICHMOND K	A91	80230	4085	.846	UPDATE	0.0	0	0
TURNER (RICHMOND K	A91	81010	7664	.953	UPDATE	0.0	0	0
TURNER (RICHMOND K	A91	81033	8219	.958	UPDATE	0.0	0	0
TURNER (RICHMOND K	A91	81062	8928	.963	UPDATE	0.0	0	0
TURNER (RICHMOND K	A91	81083	9318	.951	FINAL	7304.0	0	0
WAINWRIGHT	A80	80142	769	0.000	START	0.0	0	0
NO FINAL READING FOR THIS SHIP								

AN/USQ-69(V) RELIABILITY ANALYSIS

INDEX TO SYSTEM LEVEL RELIABILITY ANALYSIS

COLUMN

1 REMAINING SYS CAP - Percentage of remaining system capacity as a result of a reported failure

2 TTF - Time To Failure or Censored Time

3 NO. FAIL - The number of failures at a reported time

4 NO. CENSORED - Number of failure free times prior to a reported failure

5 SURVIVORS - The number of Time-To-Failures and Censored Times exceeding a reported Time-To-Failure

6 NPD - The Non-Parametric Distribution failure probability

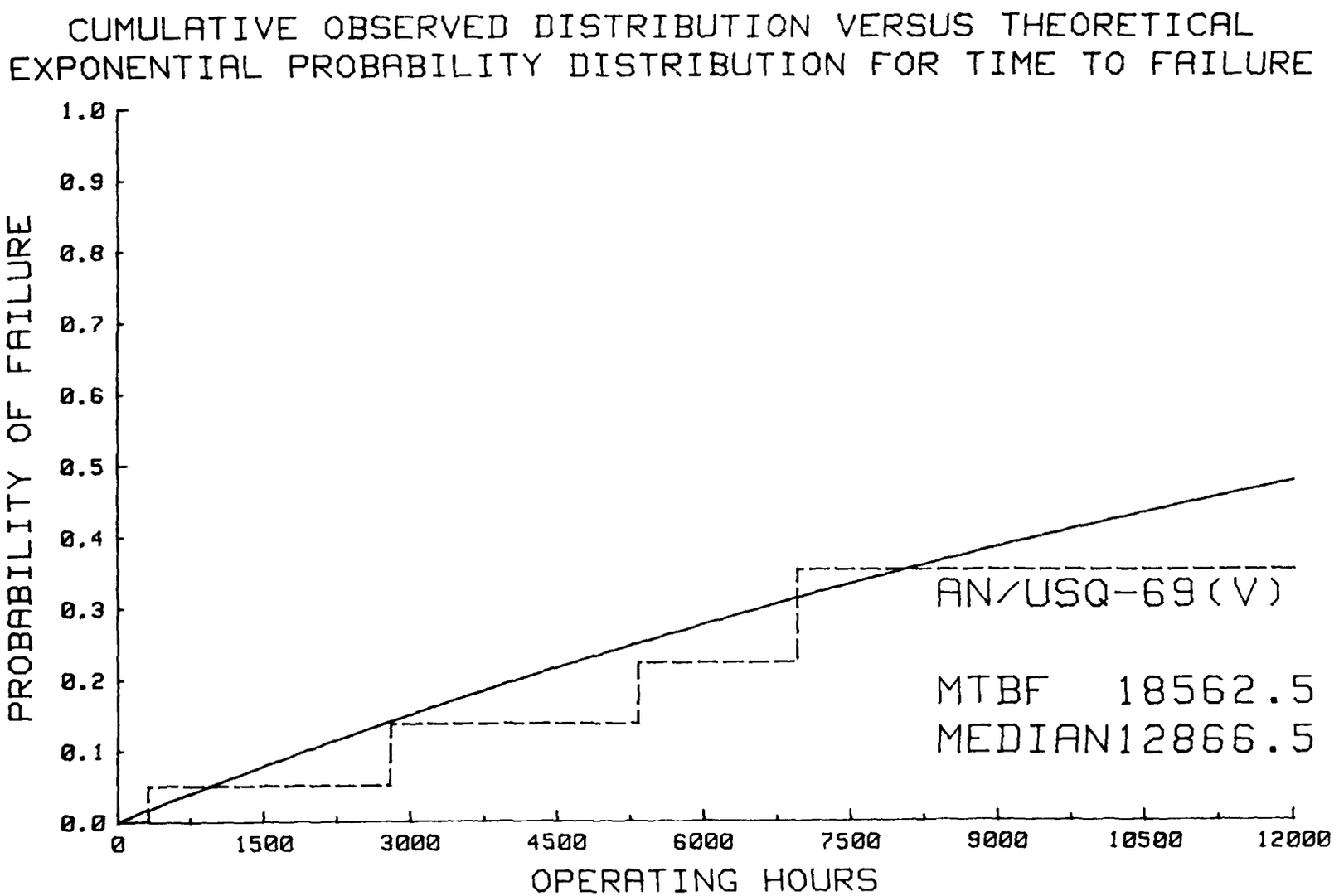
7 EXP - The Exponential Distribution failure probability

8 WEIB - The Weibull Distribution failure probability

R E L I A B I L I T Y

SYSTEM LEVEL

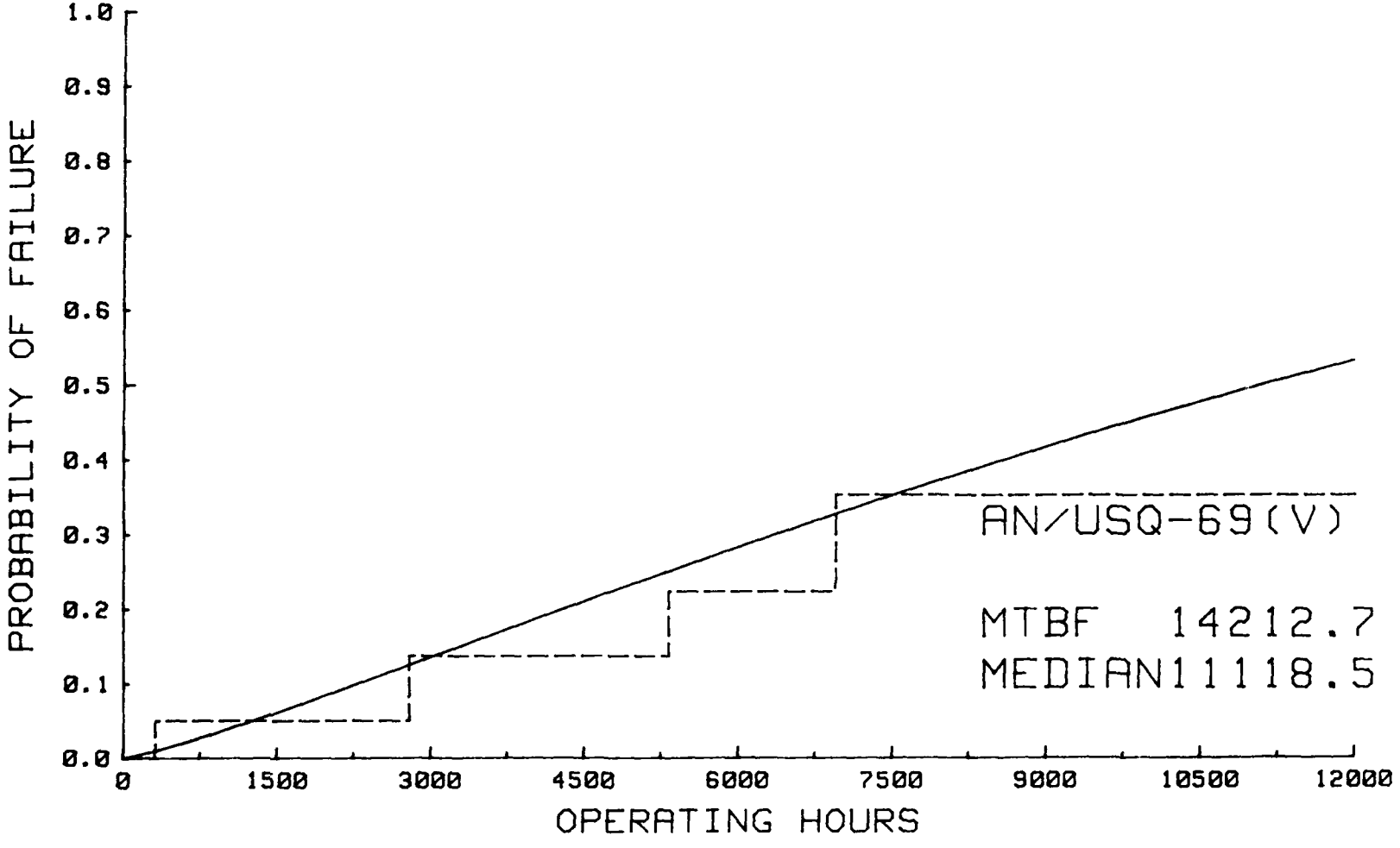
REMAINING SYS CAP	TTF	NO. FAIL	NO. CENSORED	SURVIVORS	NPD	EXP	WEIB
	29.0		1				
	178.0		1				
0	312.0	1		19	.050	.017	.010
	884.0		1				
	916.0		1				
	1000.0		1				
	1212.0		1				
	1435.0		1				
	1620.0		1				
	1696.0		1				
	1731.0		1				
0	2792.0	1		10	.136	.140	.124
0	5329.0	1		9	.223	.250	.250
	5533.0		1				
	5713.0		1				
	6374.0		1				
0	6951.0	1		5	.352	.312	.326
	7304.0		1				
	7382.0		1				
	7514.0		1				
	8345.0		1				


CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
EXPONENTIAL PROBABILITY DISTRIBUTION FOR TIME TO FAILURE
PROBABILITY OF FAILURE
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
1500
3000
4500
6000
7500
9000
10500
12000
OPERATING HOURS
AN/USQ-69(V)
MTBF 18562.5
MEDIAN12866.5

R E L I A B I L I T Y
AN/USQ-69(V) LEVEL

EQUIPMENT OPERATING HOURS(O.H.) = 74250.0
CALENDAR HOURS(C.H.) =213216.0
DUTY CYCLE (O.H./C.H.) = .348
NUMBER OF FAILURES = 4
OBSERVED FAILURE RATE/O.H. =5.3872E-05
QRATIO OF .664 EXCEEDS THE CRITICAL VALUE OF .561 FOR TEST OF EXPONENTIAL.
THE WEIBULL PARAMETERS ARE ALPHA=9.92041E-06
BETA= 1.19729E+00
FOR THE ASSUMED DISTRIBUTION:
EST. MEAN = 14212.683
EST. MEDIAN =11118.494
90% LCL FOR MEAN = 3090.993
90% UCL FOR MEAN = 25334.373
90% LCL FOR BETA= 2.05255E+00
90% UCL FOR BETA= 3.42034E-01

CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
WEIBULL PROBABILITY DISTRIBUTION FOR TIME TO FAILURE



RELIABILITY O-LEVEL SUMMARY

WRA	O-LEVEL BLOCK NO.	NUMBER FAIL.	LOWER 90 CONF LIM	MEAN	UPPER 90 CONF LIM	OBSERVED FAILURE TIMES LOW	OBSERVED FAILURE TIMES HIGH	RELIAB PROBLEM
18	011	1	19088.88	74250.00	704726.65	2792.00	2792.00	NO
18	016	1	19088.88	74250.00	704726.65	2792.00	2792.00	NO
18	017	3	11113.94	24750.00	67373.52	312.00	6951.00	YES

SUBSECTION (2)

AN/USQ-69(V) MAINTAINABILITY
(REPAIR TIME)

INDEX TO REPAIR TIME ANALYSIS

REPAIR TIME - Reported repair times

FREQUENCY - The number of times the repair time was reported

CUM FREQ - The cumulative repairs reported

NPF - Non-Parametric function

MAINTAINABILITY (REPAIR TIME)

AN/USQ-69(V) SYSTEM LEVEL

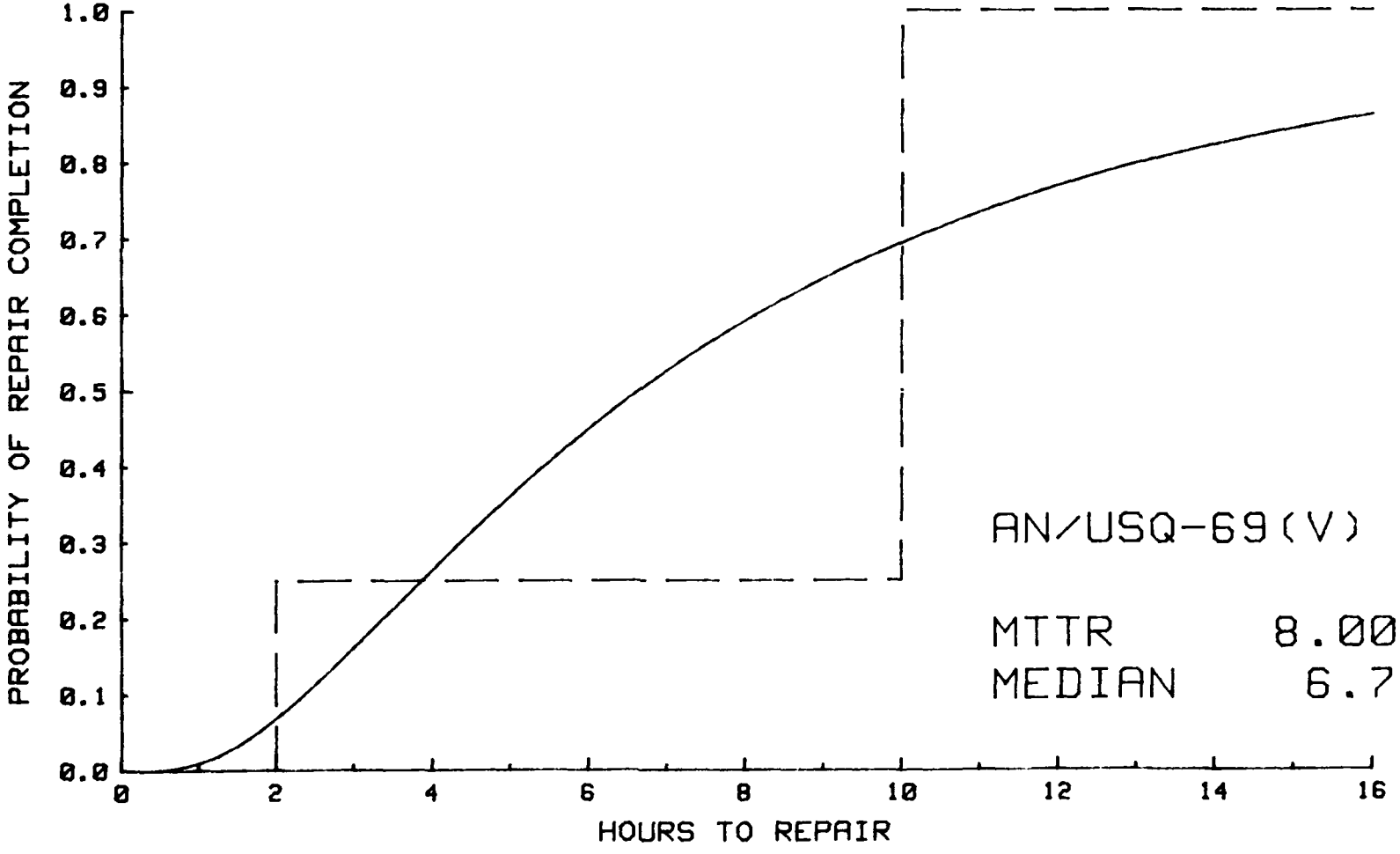
REPAIR TIME	FREQUENCY	CUM FREQUENCY	NPF
2.00	1	1	.200
10.00	3	4	.800

TOTAL REPAIR HOURS = 32.0
NUMBER OF REPAIRS = 4
OBSERVED REPAIR RATE/HR = .13

DISTRIBUTION DETERMINATION

EST MEAN = 9.24
EST MEDIAN = 6.69
90 PERCENT LCL ON MEDIAN = 2.77
90 PERCENT UCL ON MEDIAN = 16.12

CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
LOGNORMAL PROBABILITY DISTRIBUTION FOR TIME TO REPAIR



SUBSECTION (3)

AN/USQ-69(V) MAINTAINABILITY
(DOWN TIME)

INDEX TO DOWN TIME ANALYSIS

DOWN TIME - Reported down times

FREQUENCY - The number of times the down time was reported

CUM FREQ - The cumulative down times reported

NPF - Non-Parametric function for down time

MAINTAINABILITY (DOWN TIME)

AN/USQ-69(V) SYSTEM LEVEL

DOWN TIME	FREQUENCY	CUM FREQUENCY	NPF
2.00	1	1	.200
10.00	2	3	.600
480.00	1	4	.800

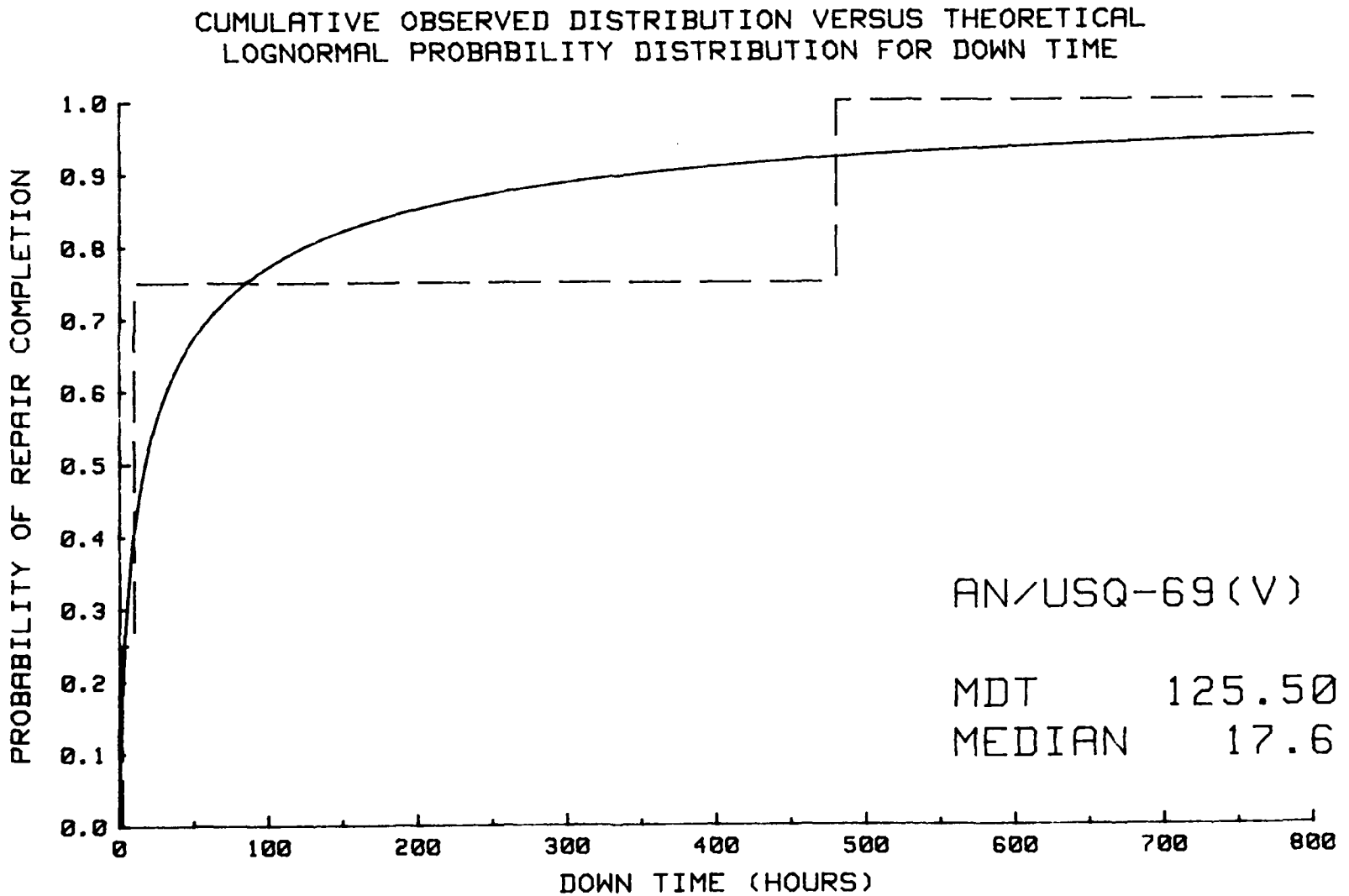
TOTAL DOWN TIME = 502.0
NUMBER OF REPAIRS = 4
OBSERVED DOWN TIME/REPAIR = 125.50

DISTRIBUTION DETERMINATION

MEAN OF LN'S = 2.87
STD DEV OF LN'S = 2.33

FOR THE LOG-NORMAL

EST MEAN = 266.21
EST MEDIAN = 17.60
90 PERCENT LCL ON MEDIAN = .01
90 PERCENT UCL ON MEDIAN = 28230.21


CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
LOGNORMAL PROBABILITY DISTRIBUTION FOR DOWN TIME
PROBABILITY OF REPAIR COMPLETION
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
100
200
300
400
500
600
700
800
DOWN TIME (HOURS)
AN/USQ-69(V)
MDT 125.50
MEDIAN 17.6

SUBSECTION (4)

AN/USQ-69(V) OPERATIONAL AVAILABILITY

Availability is described by a Monte Carlo simulation from the chosen reliability, maintainability, and down time distributions. The curve presented shows the percent of individual units (serial numbers) simulations that would be available a given percent of the time, given the assumed distributions are reasonably correct. The curves are based upon 2000 iterations of the Monte Carlo simulation.

RMA SUMMARY AN/USQ-69(V) OPERATIONAL AVAILABILITY - SYSTEM LEVEL

TTF DISTRIBUTION IS WEIBULL WITH MEAN = 14212.7

DT DISTRIBUTION IS LOGNORMALWITH MEAN OF LNS = 2.87 AND STANDARD DEVIATION OF LNS = 2.33

RT DISTRIBUTION IS LOGNORMAL WITH MEAN = 8

INHERENT AVAILABILITY = MTBF/(MTBF+MTTR)

MEAN TIME TO FAILURE = 14212.7

MEAN REPAIR TIME = 8

INHERENT AVAILABILITY = .9994

OBSERVED AVAILABILITY (SIMULATION OF RATIOS TTF/(TTF+DT)

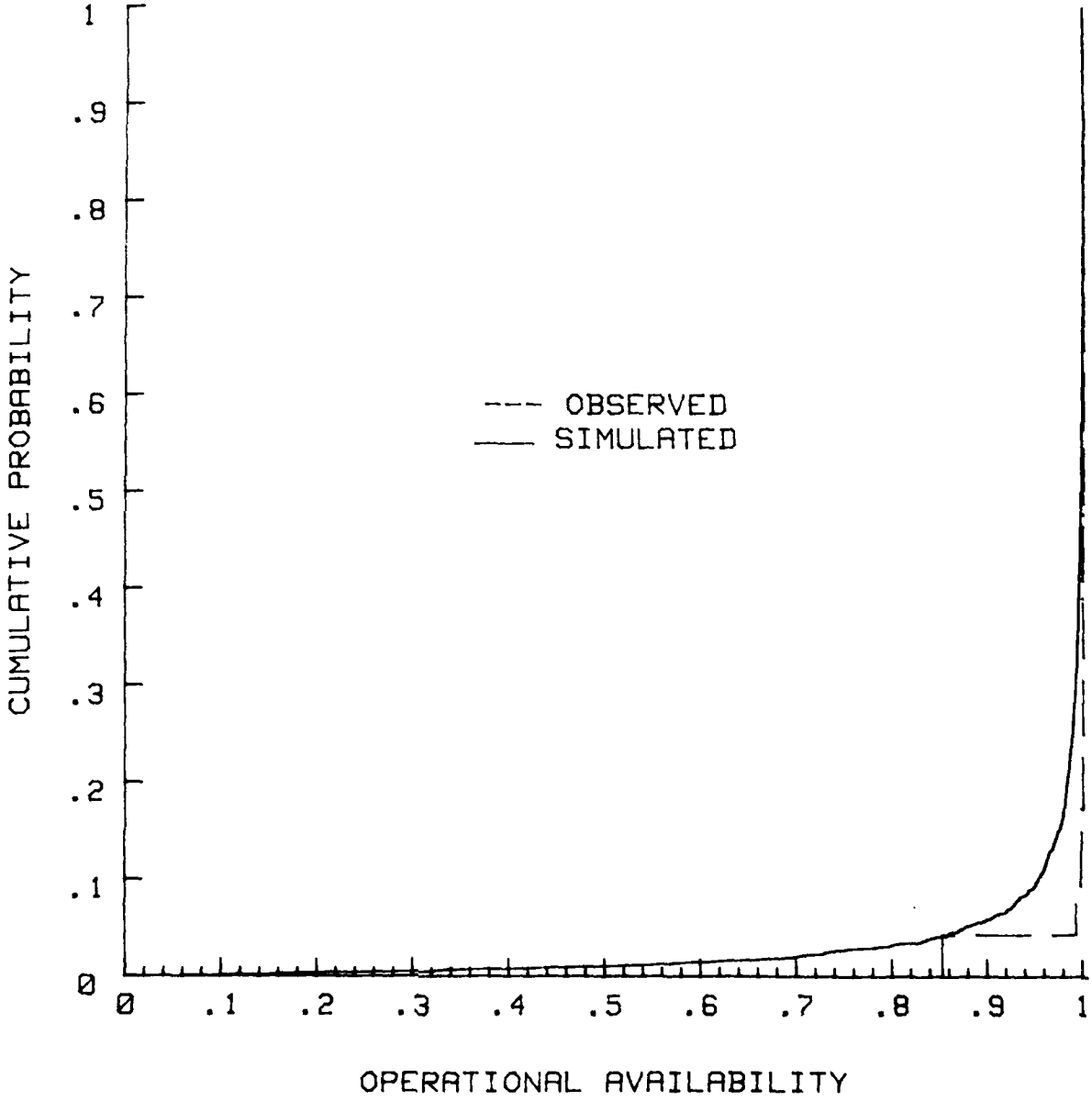
90 PERCENT LCL ON INDIVIDUALS = .9539

90 PERCENT UCL ON INDIVIDUALS = .9999

MEAN = .9743

MEDIAN = .9978

AN/USQ-69(V) OPERATIONAL AVAILABILITY
CUMULATIVE OBSERVED DISTRIBUTION VERSUS SIMULATED
OPERATIONAL AVAILABILITY PROBABILITY DISTRIBUTION




DAT
FILM